“The Utilization of Pharmacy Automation For the Reduction of Adverse Drug Events In the Veterans’ Administration Medical Center Setting”

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Abstract...

•The occurrence of adverse drug events in the United States Healthcare System is a great burden upon the nation’s resources.

•In recent years, a great endeavor has been initiated to try to find the causes, demographics, and possible solutions to help stop the vast proliferation of adverse drug events.

•The United States Veterans' Administration is a forerunner in examining new and unorthodox solutions to alleviate the burden presented by the occurrence of adverse drug events in the nation’s healthcare system.

•The fact that all Veterans' Administration Medical Centers are teaching hospitals, have an aging population that requires multiple drug regimens, and have the direct backing of the United States Government makes them a perfect testing ground for new medication management systems and dispensing technology.

•One such alternative technology that shows great promise for stopping the occurrence of adverse drug events is the use of ***Automated Pharmacy Services*** within all Veterans’ Administration Medical Centers in the United States.

Introduction...

•It has become the norm that hundreds of new, ever-potent, and pharmacologically diverse medicines are released into the mainstream pharmaceutical market every year.

•With the release of these drugs, great strides have been accomplished in treating previously inoperable disorders and improving the prognosis of patients everywhere.

•An ever-growing problem associated with these drugs, however, is the escalating occurrence of adverse drug events associated with their administration.

•The growing trend in preventable adverse drug events shows a drastic increase in number over a relatively short period of time.

Introduction, Cont...

•In 1994 alone, *702,000* adverse drug events in the United States resulted in emergency room visits or hospital admissions.

•Similarly, in the same year, *1,547,000* patients experienced an adverse drug event while being treated in an American hospital.

•By combining these numbers, the total number of adverse drug events estimated in the United States in 1994 would have been *2,216,000.*[1]

◆*Something must be done about this problem...*

Demographics, Nature, and Causes of Adverse Drug Events...

Definition:

•An ***adverse drug event*** will be classified as, "any noxious, unintended, and undesired effect of a drug, which occurs at doses used in humans for prophylaxis, diagnosis, or therapy. This definition excludes therapeutic failures and intentional misuse of a drug in abuse or poisoning. This definition does include errors in administration".[1]

•Great efforts have been exhausted trying to find the nature, causes, and most importantly solutions to help halt the vast proliferation of ***adverse drug events*** associated with the administration of drugs.

•Although there are no clear or complete solutions to this problem, recent advances in technology and drug distribution management show great promise in eliminating drug errors and eventually eliminating ***adverse drug events***.

•Before exploring possible solutions to the problem, it is important to understand how ***adverse drug events*** occur and the costs associated with them.

Costs Associated With Drug-Morbidity and Mortality In The United States...

	# of Events	Cost
Physician Visits:	115,654,949	$7,459,744,000
Additions Prescriptions:	76,347,604	$1,933,121,000
Emergency Department Visits:	17,053,602	$5,320,723,000
Hospital Admissions:	8,761,861	$47,445,477,000
LTC Admissions:	3,149,675	$14,398,644,000
Deaths:	198,815	***
Totals:	***	**$76,557,711,000**

The annual costs associated with adverse drug events in the United States are ***staggering***. These costs represent expenditures for prevention of adverse drug events, costs of post-event treatment of patients, and all-to-often the costs associated with litigation after the injury of a patient.

In 1994, drug-related morbidity and mortality constituted a cost of ***$76.6 billion*** (C.I. $30.1 to $136.8 billion) to the United States healthcare system.[7]

Causes of Death In America During 1994...

Ranking:	Disease State:	# of Deaths:
1st	Heart Disease	**743,460**
2nd	Cancer	**529,904**
3rd	Stroke	**150,108**
***4th**	Adverse Drug Events	**137,000**

*Adverse drug events would constitute the fourth leading cause of death in the United States if the upper limit (137,000 deaths) of the tabulated critical interval derived by Lazarou et. al. were used. If the lower limit (76,000 deaths) were used, adverse drug events would constitute the sixth cause of death after pulmonary disease (101,077 deaths) and accidents (90,523 deaths)in the United States.[1]

•The greatest cost realized by the American healthcare system as a result of adverse drug events is the loss of human life.

•In 1994, adverse drug events were believed to have taken 106,000 American lives. This would translate into 4.6% (106,000 of 2,286,000) of all deaths during 1994 being caused by adverse drug events. Mathematically, this would make adverse drug events the ***4th*** leading cause of death in America. The only other causes of death that superceded adverse drug events in 1994 were heart disease, cancer, and stroke.[1]

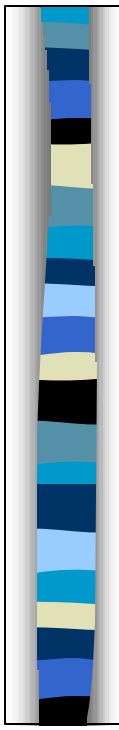
Recommendations To Reduce The Number of Adverse Drug Events and Improve Patient Care...

In 1994, the ***American Society of Hospital Pharmacists*** supported a joint coalition with the American Medical Association and the American Nurses Association to study the occurrence and possible preventability of adverse drug events.[9] After much review, the coalition derived seven main actions that hospitals could enlist to help reduce the number of adverse drugs events. The seven possible actions that hospitals could enlist to reduce adverse drug events are summarized below:

1. *Hospitals should establish processes in which prescribers enter medication orders directly into computer systems.*
2. *Hospitals should evaluate the use of machine-readable coding (e.g., bar coding) in their medication-use processes.*
3. *Hospitals should develop better systems for monitoring and reporting adverse drug events.*

Recommendations To Reduce The Number of Adverse Drug Events and Improve Patient Care, Cont...

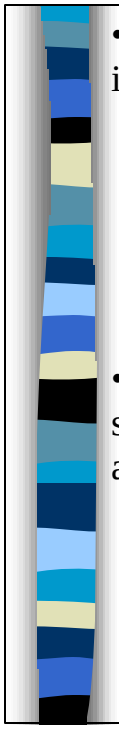
4. *Hospitals should use unit-dose medication distribution and pharmacy-based intravenous medication admixture systems.*
5. *Hospitals should assign pharmacists to work in patient care areas in direct collaboration with prescribers and those administering medications.*
6. *Hospitals should approach medication errors as system failures and seek system solutions to preventing them.*
7. *Hospitals should ensure that medication orders are routinely reviewed by a pharmacist before first doses and should ensure that prescribers, pharmacists, nurses, and other workers seek resolution whenever there is any question of safety with respect to medication use.*[9]



•All seven of these recommendations have the design and ability to greatly reduce the number of medication errors and adverse drug events in the United States.

•In order to realize the benefits of the above recommendations, essential system changes must be made.

•Currently***, Automated Pharmacy Services*** show the greatest promise for fulfilling the proceeding seven recommendations and greatly reducing ***Adverse Drug Events*** in medication administration...



•***Pharmacy Automation*** is beneficial in the fact that it can out-perform humans in tasks that require:

- •tedious repetition.
- •tiresome movement.
- •intense concentration.
- •immense memory retention.
- •meticulous record keeping.

•Furthermore, ***Automated Pharmacy Systems*** are superior to manual pharmacy systems because they are able to:

- • reduce medication errors.
- •improve documentation.
- •improve and increase authorized access to medications and information.
- •enhance security within the pharmacy.

The greatest benefit associated with <u>Automated Pharmacy Services</u> is the promise of granting pharmacists greater access to patients and allowing pharmacists to do what they were trained to do…

- *Ensure positive **pharmacotherapeutic outcomes** for their patients.*
  - Pharmacy Automation truly enables a vast re-engineering of the entire practice of pharmacy and allows the individual pharmacist to escape the confines of pharmacy distribution and embrace the practice of true ***pharmaceutical care***.
  - Currently, there are over ***190,000*** licensed pharmacists in the United States.
  - A full two-thirds of these people practice in community pharmacies.
  - By removing the burden of pharmacy distribution, pharmacists in the community settings would have direct contact with patients and an easier means of ensuring ***pharmaceutical care*** for their patients.
  - This would also hold true for pharmacists working in the inpatient hospital setting...

Automated Pharmacy System Providers...

Company Name	Location	Company Name	Location
ADDS	Bellerica, MA	KVM Technologies	Houston, TX
ApotheTech	Colombus, OH	LifeServ Technologies	Clearwater, FL
Autros	Toronto, CAN	Lionville Systems	Wxton, PA
AutoMed Technologies	Buffalo Grove, IL	McKesson APS	Pineville, LA
Baxter Healthcare	Round Lake, IL	McKesson Automated Healthcare	San Francisco, CA
Bridge Medical	Solana Beach, CA	Medical Packaging Systems	Ringoes, NJ
Diebold	Canton, OH	Medical Technology Systems	Clearwater, FL
Health Care Systems	Birmingham, AL	NextRx	Bothell, WA
Health Systems Services	Houston, TX	Omnicell Technologies	Palo Alto, CA
Innovation Technologies	Johnson City, NY	Pyxis Corporation	San Diego, CA
Integrated Dispensing Systems	N/A	Script Pro	Shawnee Mission, KS

- Just ten years ago, there were only five American firms that offered pharmacy automation products and / or services. Today, that number has grown to more than thirty providers and continues to rise every year (Please see table above).
- Similarly, the number of acute care hospitals utilizing some form of pharmacy automation has grown from almost none to more than 3,000.[10]
- A list of benefits associated with Automated Pharmacy Systems is presented on the next slide...

The Greatest Advantage...

•When ***pharmacists*** are allowed to participate directly in patient care:

- •patient outcome is improved
- •length of stay is decreased
- •total cost of medical care is reduced.

•When pharmacists are not burdened with distribution and are allowed to concentrate on patient care, the result is an overwhelmingly positive patient outcome.

Pharmacy Automation Allows This To Happen...

Example 1:

•It was determined that ***$3.9 billion*** was spent in 1983 in the United States to manage the preventable gastrointestinal adverse effect of non-steroidal anti-inflammatory drugs (NSAIDS).[12]

- •It was also determined that these costs could have been easily avoided if drug information experts such as ***clinical pharmacists*** were more closely involved with the individual patient's pharmaceutical care in that particular setting.

Example 2:

•In a recent study performed by George Haig and Lori Kiser, it was determined that utilization of pharmacists on medical teams within hospital acute care wards was directly related to:

- •reduced pharmacy costs and charges.
- •reduced hospital charges.
- •reduced patient length of stay.[13]

Savings Realized When Pharmacists Were Included On Patient Care Teams

	Control Team (A)	Pharmacist Team (B)	p-Value
Pharmacy Costs:	$278	$173	*0.0124*
Pharmacy Charges:	$1,020	$652	*0.0008*
Hospital Charges:	$8,187	$6,122	*0.0013*
Length of Stay:	7.2 days	5.9 days	*0.0036*

Example 3:

•Recently, the most convincing evidence promoting the removal of pharmacists from dispensing functions and inclusion into clinical medical teams was published in the July 21, 1999 edition of the Journal of the American Medical Association.

- •The study, "Pharmacist Participation On Physician Rounds And Adverse Drug Events In The Intensive Care Unit" was performed by Leape et. al. in a large urban teaching hospital.
- •The study was designed to measure the effect of pharmacist participation on medical rounds in Intensive Care Units of teaching hospitals.

Number of Preventable Adverse Drug Events Avoided When Pharmacists Are Included On ICU Medical Teams

	Study Group	Control Group
Rate of Preventable Ordering Adverse Drug Events Per 1000 Patient Days:	***3.5***	***10.4***
Percentage Drop In Adverse Drug Events:	***66%***	

Cost Avoidance Realized When Pharmacists Are Included On ICU Medical Teams

	Study Group	Control Group
Adverse Drug Events Prevented:	58	N/A
1995 Cost Per Adverse Drug Event:	$4,685.00	N/A
Total Cost Avoidance:	***$271,730.00***	N/A

Example 4...

•A similar study examining the effectiveness of pharmacists in the hospital setting was performed by Bjornson et. al. to look at the ***cost : benefit ratio of pharmacists on medical care teams***.

•This study compared data collected for 3,638 patients at **Walter Reed Army Medical Center-Washington, D.C.**

•When pharmacists were included on medical care teams, it was shown that:

• ***$377.00*** per patient admission was saved.

•Annual return on investment for all staff pharmacists was ***$150,951.00***.

•Length of patient stay was significantly reduced (***p=0.032***).[15]

Description of Favorable Results When Pharmacists Are Included On Medical Teams In An Army Hospital

Category Reviewed	Results
Amount Saved Per Patient Admission:	$377.00
Return On Investment For Pharmacists:	$150.951.00
Length of Stay:	Significantly Reduced (p=0.032)

Review of Three Automated Pharmacy Systems...

•With over thirty providers of automated pharmacy systems, there is great competition between companies to dominate this market.

•The three Automated Pharmacy Systems that this section will review are…

1. The **MedStation Rx System** produced by **Pyxis** of San Diego, CA.
2. The **Robot-Rx System** produced by **McKessonHBOC Automated Healthcare**.
3. The **NextRx System** produced by **NextRx Corporation of Bothell, WA**.

The ***MedStation RX System...***

- The ***MedStation Rx system*** promises:
  - Dramatically decreased inventory costs.
  - Automation or elimination of many of the steps in the medication and supply distribution process (thereby reducing labor costs).
  - Tracking of medication and supply usage, controlled access for authorized personnel only.
  - Reduced medication adventures (adverse drug events).
  - Increased time and energy that staff can direct to patient care.[17]

The MedStation Rx System is an automated, computer-controlled device that stores and directly dispenses medications in hospital nursing wards.[18]

- The **MedStation Rx** was recently evaluated in a 600-bed teaching hospital.
- The **MedStation Rx** was preferred by the nursing staff because it had the ability to identify:
  - The person removing medications for a particular patient.
  - The patient for whom the dose was intended.
  - The time of the transaction.

- Manual medication distribution error rate = ***16.9%*** (***148*** per ***873*** observations)**.**
- MedStation Rx medication error rate = ***10.4%*** (***97*** per ***929*** observations***).***
- The overall medication administration error rate for the hospital had fallen by ***38.50%*** by utilizing the MedStation Rx automated pharmacy system.[18]

Outcomes Observed By Utilizing the Pyxis MedStation Rx Automated Medication Dispensing System

Variable		Manual Distribution	Medstation Rx
# of Observations:		873	929
# of Medication Errors:		148	97
Total Error Rate		**16.90%**	**10.40%**
Total % Drop In Medication Errors:	**38.50%**		

The ***Robot-Rx system...***

•McKesson was one of the first companies to successfully build and deliver Automated Pharmacy Services that could save money and greatly reduce a medical facilities medication errors and resulting adverse drug events.

•The Robot-Rx System is beneficial because it:

- •Reduces pharmacy costs.
- •Frees up pharmacists for clinical activities.
- •Ensures proper prescribing, dispensing, administration of drugs, and medication monitoring.

•In July of 1999, **McKessonHBOC** performed a ***cost : benefit analysis*** to study the implementation of automated pharmacy services into the inpatient pharmacy of the Durham Veterans' Administration Medical Center in Durham, North Carolina.

•Total Robot-Rx investment would equal ***$1,439,714.00***.

- •Allowing the Durham VAMC inpatient pharmacy to dispense up to ***95%*** of its medications by automated pharmacy distribution.

•After considering redeployment of pharmacists to clinical duties within the hospital and elimination of other costs such as inventory, total savings potential would equal ***$2,699,148.00***.

•This would translate into a net savings of ***$1,259,434.00*** and a return on investment of ***41.3%*** for the Durham VAMC in just 5 years time.[20]

Net Savings Potential and Return On Investment By Utilizing The McKesson HBOC Robot-Rx Automated Healthcare System

Total Robot-Rx Investment:	**$1,439,714**
Total Savings Potential:	**$2,699,148**
Net Savings Potential:	**$1,259,434**
Return On Investment:	**41.30%**

•After an unbiased study, it was determined that the Durham VAMC Inpatient Pharmacy would benefit from the implementation of Automated Pharmacy Services.

The final company to be reviewed is a relative new-comer to the Automated Pharmacy Services field...

- The ***NextRx Corporation*** is located in Bothell, Washington and offers "true unit-dose technology" to its customers.
- The ***NextRx*** family of products include:
  - ***The "NextCentral"…***
    - A "dock-side to bed-side" medication distribution system.
  - ***The "NextCart"…***
    - The ultimate in cart-filling which has the capability to hold all medications, including refrigerated, scheduled, narcotics, PRNs, and first doses.
  - ***The "NextPatient"…***
    - Able to scan patient wrist-bands and medications to ensure accurate dosing.[21]

- Although there is no data attesting to the validity of the ***NextRx System***, it's technology possesses all of the attributes and benefits that Automated Pharmacy Services have always aspired to provide.
- ***The NextRx System*** has the promise of being the first totally-integrated Automated Pharmacy System, automating the dispensing of unit dose medications from original order entry to medication administration at the patient's bedside.
- Furthermore, since the ***NextRx system*** was developed by physicians, pharmacists, and nurses jointly, it possesses the refinement ideas of the major healthcare professions which would benefit most from the ***"system's"*** implementation in the hospital setting.
- In all, each of the three systems are fine examples of Pharmacy Automation and would be beneficial to inpatient hospital pharmacies by:
  - Reducing medication errors.
  - Reducing hospital costs.
  - Reducing patient costs.[21]

Conclusion...

•In the pharmaceutical field, things change at an amazing pace. In the early 1960's, the newest technology that promised to revolutionize the practice of pharmacy was the use of unit-of-use or unit-dose packaging for the convenient dispensing of medications.[22] Now, dispensing medication is more of an art form than merely a function of a job. The pharmacist of the not-so-distant future will have to possess the knowledge of a clinical practitioner, a benevolent and kind counselor of patients, and possibly (to some extent) be a wizard of complex automated filling systems.

•In the past, Automated Pharmacy Systems were out of the reach of most health care facilities due to expense and the inability of pharmacy departments and nurses or physicians to agree on what they wanted from the technology.[23] Can American healthcare professionals ignore new technologies that are available and allow the widespread problems and related dangers of adverse drug events to continue to spiral upward and out of control? The answer is (quite simply) "no".

•As pharmaceutical healthcare providers, we have an inherent responsibility to continuously search out new means of improving patient therapy and outcomes. Before good pharmaceutical outcomes will ever be realized, the profession of pharmacy must cut loose the *Albatross* of adverse drug events that hangs around the neck of all American healthcare providers. Automated Pharmacy Services should be evaluated and adopted if they show a drastic reduction in the occurrence of adverse drug events. ***The findings of this study firmly point in the direction of implementation of Automated Pharmacy Services in the inpatient hospital pharmacy setting***.

Questions?

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